Teleportation and the Printed Human

Harrison, Paul

Published in:
IMPACT 9 International Printmaking Conference Proceedings

Publication date:
2015

Document Version
Peer reviewed version

Teleportation and the Printed Human

Paul Liam HARRISON
Duncan of Jordanstone College of Art & Design, University of Dundee

ABSTRACT

In this paper I intend to articulate a biological perspective on the indexical form and discuss some of the issues raised by this proposition. I will pay particular attention to perhaps more peripheral concepts that are currently being pursued such as tissue and organ printing and quantum biology.

PREAMBLE

The history of print takes us from the evidence of the first human graphic expressions on cavern walls to the most recent technological innovations. From palm print to pixel, from manual to mechanical to electronic reproduction - it has defined the development of our cultures both locally and globally, particularly in the transitional periods from the medieval to the mechanical age and then subsequently through the electronic to the present era of digital information technology. If print is considered in this, its broadest sense; 'as the indexical form of any matrix' it can be considered also as continuing its increasingly pervasive presence in all aspects of contemporary life.

In this sense then, it is clear that printed matter and print methods are central to the development and debate regarding new technologies. As the 'information revolution' increasingly permeates and dominates our lives I suggest that we have consequently and collectively already embarked upon a 'biological revolution' that incorporates and adapts print technologies and concepts as a central and significant foundation for these biotechnological processes.

Methods of replication and reproduction for example, whilst being celebrated by the artist/printmaker, also provide the basis for research into genetics and cell biology and as such are crucial tools in the study and treatment of cancer and hereditary diseases. Even the concept of replication itself is central to the validity of the scientific process.

1. INTRODUCTION

In 2004 I came across a series of published articles heralding the development of a new form of biological reproduction now known as Organ or Tissue Printing. A group of scientists in the U.S. were adapting print technology and applying it to organic matter. Dr. Vladimir Mironov and Dr.Thomas Boland, were interviewed as pioneers in this field. In these early articles Mironov stated: 'This could have the same kind of impact as Gutenberg's press. Instead of ink, we're substituting components such as a growth medium and cells - which, just like ink, can be directed through the nozzle' - to produce forms. 'If everything works as we hope it will, this could be a great contribution to personalized medical care,' said Boland. 'Every hospital would have a printer with the components to make a fully functioning organ.' [1]

I subsequently contacted Dr. Mironov at the University of South Carolina and we began to correspond. He pointed me to the 1st World Bioprinting Congress in Hawaii 2007 – which somehow confirmed the anticipated reality of this technology. The bio-printer has since been manufactured (tissue samples and blood vessels have being successfully printed) - and there

seems to be several companies already competing in the future market. A slideshow ‘How to print Organs’ is available on line for example, illustrating a print technology that uses bio-ink particles rather than pigment – one liquid made up of the appropriate cells and another of structure substrate such as collagen gel. Another more comprehensive and theatrical presentation is a popular online TED lecture by Professor Anthony Atala who demonstrates a flatbed type printer that actually scans and prints directly onto the patient to fill in wounds or replace damaged tissue and a 3D printer that uses living cells to output a transplantable kidney. Using similar technology, a young patient of Dr. Atala's received an engineered bladder 10 years previously; he joins him on stage.[2]

An article in Time Magazine reads: ‘Spare parts are available for virtually any machine ever invented. So why not the human body? Two San Diego–based companies have developed what amounts to a dot-matrix printer for human organs. The device, small enough to fit into a sterile biosafety cabinet, consists of two printheads — one that sprays out a gel that forms a sort of armature for an organ and another that fills in that scaffolding with living cells. The printing tip positions cells with a precision within microns. Livers, kidneys and other replacement components — including teeth — could be built on demand, with no wait for a donor and less risk of rejection, since the cells are harvested straight from the patient. No word yet on a parts-and-labour warranty.’[3]

2. FAX OR FICTION

As this technology has developed over recent years the research has also presented other parallel opportunities such as – In vitro meat – and although the printing of foodstuff, particularly meat, along with human organs does seem to present some interesting ethical questions it is yet another area of reproduction which until recently would have been considered by most as the realm of fantasy or Science Fiction.

Thinking of tissue regeneration or re-construction might conjure image references to cult movies such as Xmen, and Terminator or classic novels such as Mary Shelley’s Frankenstein. Indeed, the notion of regeneration or re-conditioning of human organs is certainly nothing new. In Greek mythology Prometheus has his liver replenished each night, after having it eaten daily by an eagle - interestingly as a punishment from Zeus for stealing Fire (incidentally the means of life) from the gods to give to the mortals.

How closely then does myth or science fiction mirror the aspirations of the real world? How often, or perhaps how quickly, does science fiction become science fact? – and inversely how often are prevailing scientific theories disproved in line with the most recent paradigm shift.[4] The point is that living tissue is now being printed and enabling incredible new treatments that were unimaginable yesterday. Practically and conceptually – ‘Then was now’ ‘This is tomorrow’.

With this in mind - another concept that I would, until recently, have considered purely a science fiction phenomenon is Teleportation. I certainly never recognized it, even in principle as a form of replication or reproduction. It seems however that replication is a more fundamental aspect of the broader physical and mechanical universe than we may have anticipated.

If we consider the concept of teleportation then we might think again of a whole array of recent Science Fiction images - TV programmes and movies such as Star Trek or the Fly. The notion of Tele-transportation however is again nothing new. Ideas of physical transportation or transformation across great distances clearly hark back to ancient times – collective belief in shamens for example still exist in many traditional cultures. Even the major contemporary belief systems include stories of supernatural physical transportation as well as physical regeneration.

The first time I considered the concept of Teleportation in any other way than as a literary mechanism for moving fictitious characters from one place to another without having to laboriously describe the journey was in 2006. At this time I attended a seminar in Edinburgh at the ESRC Genomics Policy and Research Forum hosted by artist, Alastair Gentry and including, as invited guest, Quantum Physicist Professor Vlatko Vedral. Vlatko discussed his collaboration with Leeds based theatre company Tangle and their production based upon his research into teleportation. Vlatko informed us that his and other labs around the world were already successfully teleporting tiny quantities of matter (sub atomic particles) from one location to another and it was only a matter of time before larger particles could be teleported also. My subsequent research has confirmed the first teleportation took place in Innsbruck in 1997 and is now a routine procedure in laboratories around the world. (My further surprise was how little attention this had received outside of the scientific community - Quantum and Information Physicists that is).

One of the aspects of the seminar discourse that resonated with me particularly was the notion that teleportation appeared to be more of a reproductive process rather than strictly a method of transportation. It was suggested that Teleportation in 'real ' practice, functions as a process comparative to a Fax. The original material or matrix is scanned and sent as a coded signal via a standard information network system to a pre programmed point of arrival where it is automatically reconstituted as a facsimile – a reproduction – an index – a print!

There is one major significant difference however when it comes to Teleporation – unlike a conventional fax the original matrix is destroyed! In Star Trek (Trekkie) terms this would imply that when we see Captain Kirk shimmer out of the scene we witness his destruction – we see him being scanned, disassembled and his particles completely destroyed, as the information that constitutes Kirk is extracted for transmission to some other point. When we see him subsequently, shimmer back we would therefore be witnessing the facsimile assembly or replication - or print of Kirk - constructed from local material or particles based upon the transmitted data.

After the seminar the discussion with Vlatko continued over dinner with the philosophical and ethical implications that would arise if this process of Teleportation became capable of handling large organisms like humans (in the same manner as in Captain Kirk). For example, would you want to be teleported if you knew that any teleported object is destroyed when sent, and only reconstituted at the far end from available molecular material? This clearly raises questions as to whether the object (or person) that comes out at the receiving end is the same as the one that went in, or is it merely a copy? Vlatko confirmed that he would.

This reminded me of a text by Roland Barthes in which he discusses Homers mythical and legendary boat the 'Argo'.[5] According to his interpretation: The 'Argo', as a result of the continual processes of damage and repair, due to the extreme nature of its journey, had been completely rebuilt by its end. Thus raising the question, in regard to any magical powers which may have been bestowed upon it; was it still actually the 'Argo'? The point been emphasised here is that the power belonged to the name or idea of the 'Argo' and not its physical ('original') construction. Therefore the object can be replaced without disrupting the embodied idea.

A further discussion that resonates here is a conversation I had with Director of the Wellcome Trust Centre for Gene Regulation and Expression Angus Lamond whilst collaborating with him on a series of prints. This discussion adopted the same principle but from a much more biological perspective. We were considering the nature of cell reproduction and in particular the vigorous growth of the HeLa cells that we were currently viewing.

HeLa cells are a cell line that are familiar to any biologist carrying out research into cell function and related problems such as cancer. They are a mainstay in biomedical research laboratories around the world. They are live cells in culture – the first cell line in fact to be successfully grown in the laboratory. The 'original' cells were routinely removed from a young black women in 1951 during treatment for a tumour on her cervix. Her name was Henrietta Lacks and she died later that year as a result of that same tumour. These same cells however live on - replicating every 24 hours – twenty times faster than her normal cells would have done.

It is difficult to calculate, even approximately, the quantity of Henrietta's cells that are alive today – more than sixty years after her death. According to Rebecca Skloot's recent book 'The Immortal Life of Henrietta Lacks': 'One scientist estimates that if you could pile all HeLa cells ever grown on to a scale, they'd weigh more than 50 million metric tons…another calculated that if you could lay them all end to end they would wrap around the Earth at least three times, spanning more than 350 million feet. In her prime Henrietta herself stood only a little over five feet tall.'[6]

Returning to my discussion with Angus Lamond we noted that all of the cells in our bodies are reproduced and replaced with observable regularity. This invariably prompts similar questions as to who we physically really are. The molecules that construct us change constantly. We are therefore, like the 'Argo' physically no longer who we were at the beginning of our journey – or even yesterday. We exist therefore, like Henrietta's cells, in the idea of who we are, and not as a fixed physical entity but as information in physical form – our physical structure is repeatedly reproduced and renewed from available molecular material – which is good news for the Teleporters!

Physicists such as the celebrity Dr. Michio Kaku, and of course Vlatko himself, claim that it is increasingly likely that the teleportation of organisms will eventually be a reality and that it is simply a matter of resolving the 'technical issues' – suggesting with certainty that molecules and basic life forms such as viruses will be successfully teleported within the decades ahead. Now that the system has been tested and proved it does seem inevitable that the teleportation of larger and more complex structures will ultimately become a reality.

David Darling's book 'Teleportation: The Impossible Leap' describes a future scenario where teleportation is a routine method of transportation. The preface highlights an interesting theoretical transitional period where the majority of people regularly teleport – but in so doing leave a decreasing population of 'originals' - those who have resisted or not yet been 'copied' or 'printed'.[7]

If this form of copying was ever to be achieved however it would require the technological accuracy to scan the most minute/quantum detail in order to obtain the level of information required for reproduction or printing.

Of course, it is questionable that there could be such a thing as identical reproduction. On many levels there are bound to be variations – be they slight and superficial or more substantial – either visible and surface or microscopic and structural. As printers we recognize the margins of variation within an edition – the margins of difference vary depending upon the particular system, environment and professional expectations. Physicists, engineers and information designers might talk of the degree of entropy within the system.

If truly identical - 100% accurate reproduction is unlikely – then what does this imply for theoretical teleportation? Does it mean that there are slight adaptations each time the process might be undertaken? – a slight genetic variation for example? If so, would this be akin to evolving? – a form of rapid evolution?

If we presume that this would be the case and that slight variations would be an integral aspect of teleportation, would this margin of potential variation be considered too great a risk or simply a minor and acceptable collateral effect. I suggest that these variations may not only be accepted but may ultimately be desired. Personal and physical adaptations and alterations are a common feature of human cultures – not just a feature of contemporary western culture but a diverse historical and geographical one – be it body painting and adornment or psycho therapies and cosmetic surgery – there is an appetite for transformation.

3. INFORMATION ENTANGLEMENT & QUANTUM BIOLOGY

In his book 'Decoding Reality' Vlatko suggests that information is physical and subsequently that the Universe can be considered as an information system. That everything in the Universe is connected – at the quantum level at least – regardless of proximity, and although we may not be able to physically travel at light speeds - information can.[8] The basis of this theory is a process called Entanglement, and it appears to suggest the means by which information can be transferred instantaneously regardless of distance (Teleportation). This of course offers great theoretical potential in the development of quantum computer systems.

Einstein attempted to dismiss Entanglement as 'Spooky action at a distance" because it does not align with the traditional scientific paradigm of prevailing order and purpose. The current paradigm view however confirms that at the quantum level chaos prevails and should be celebrated - particles can exist at different locations simultaneously and in different forms, because – at a quantum level – once particles have interacted they become entangled – meaning that they are connected – even after dividing and regardless of distance. As well as being an ongoing

conundrum for physicists attempting to explain the structural processes of the physical universe, it appears that entanglement might also, perhaps obviously in the circumstances, be a fundamental replication process at the heart of our biological make up.

When I began to write up these ideas a few years ago I contacted Vlatko outlining my thoughts and asking if he could point me in the direction of any further references that might suggest relationships between teleportation and print/reproduction. In response he quickly forwarded me a paper, entitled 'Entanglement Swapping Model of DNA Replication' (2011). This paper suggests that the structure – that familiar image of a DNA double helix, might actually be a result of entanglement. 'According to the central dogma of molecular biology, genetic information stored in double-stranded DNA is duplicated by replication of two strands independently.' However, there are several unknown aspects of this replication process and this paper points to them being Entangled Pairs – a theory which explains their inextricable connection but also implies that this connection is not defined nor restricted by proximity.[9] So, whether we are looking at the production of living tissue, DNA or quantum mechanics there appears to be a connection through the consideration of reproductive systems. A theory which seems to be borne out in current bioscientific terminology – with research areas such as Epigenetics, Systems Biology and a new and tentative field of research called Quantum Biology.

4. IN SUMMARY

If the Universe is physically constructed from Information as Vlatko suggests – and reproductive processes are integral to our information systems - then print is clearly more deeply connected to what it means to be human than we might consider on the surface of things. (A print is essentially an information transfer from a particular matrix).

We have already begun printing cells, live tissue and even particles at a sub atomic level. We must therefore address the question: What might the effects of developing further reproductive (print) technologies be upon our biology and future biological systems? With the population of the World increasing exponentially and set to reach 7.5 billion within the coming years (more than trebling in my own lifetime) it is certainly something to bear in mind. There is clearly a huge appetite for reproduction – but how will this reproductive technology transform us and where will it take us ?

ACKNOWLEDGEMENTS

Professor Vlatko Vedral, University of Oxford & Professor Angus Lamond, University of Dundee

REFERENCES

1. Choi, C. http://www.newscientist.com/article/dn3292-inkjet-printing-creates-tubes-of-living-tissue.html#.VZG5OifQxkU New Scientist, 22nd January 2003
2. Atala, A. Printing a Human Kidney. TED Talk, March 2011 http://www.ted.com/talks/anthony_atala_printing_a_human_kidney?language=en
3. Kluger, J. http://content.time.com/time/specials/packages/article/0,28804,2029497_2030617_2029812,00.html Time Magazine, 11th November 2010
4. Kuhn, T.S. The Structure of Scientific Revolutions. University of Chicago Press. 1962
5. Krauss, R. The Originality of the Avant-Garde and Other Modernist Myths. MIT Press, 1986 (Barthes, R. Roland Barthes. 1977)
6. Skloot, R. The Immortal Life of Henrietta Lacks. Crown Publishing, New York, 2010
7. Darling, D. Teleportation: The impossible Leap. John Wiley & Sons, New Jersey, 2005
8. Vedral, V. Decoding Reality. Oxford University Press, 2010
9. Pusuluk, O. & Deliduman, C. Entanglement Swapping Model of DNA Replication. Cornell University Library, (2011)

Address: Dr Paul Liam Harrison, Duncan of Jordanstone College of Art & Design
University of Dundee, Perth Road, Dundee, DD1 4DY, UK
E-mail: p.l.harrison@dundee.ac.uk